

NuTRoNS: Nucleonica Training on Nuclear Science

MEL Monaco, 12th October 2010

Using Nuclide Mixtures in Nucleonica

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Consultant





Nuclide Mixtures:

- Why mixtures ?
 - Mixture vs. simple nuclide
 - in the real life: mainly mixtures
 - Mixture vs. Compound
 - Nuclear properties are independent from chemical bonds
- Often used module in other applications



Mixtures in Nucleonica

1. Nuclide mixtures overview e.g. U232+Co60
2. Case study with natural uranium
3. Exercise



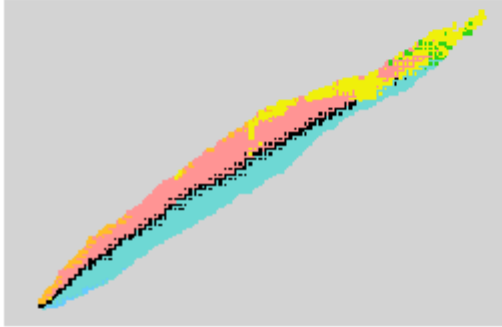
Go to Nuclide Mixtures

Logged in as: rdf Networkin **Nuclear Science** Search Forum Calculator Privacy Legal Logout

nucleonica ... web driven nuclear science

Applications Data Knowledge My Preferences Help New Alerts

► **Nuclide Explorer**



» Actual Chart: Karlsruhe

► **Application Centre**

- » Mass Activity Calculator
- » Decay Engine
- » Dosimetry & Shielding
- » Range & Stopping Power
- » webKORIGEN
- » Universal Nuclide Chart
- » Transport & Packaging
- » Nuclide mixtures**
- » Nucleonica Scripting
- » Library creation for 3rd party software
- » Gamma Spectrum Generator
- » Gamma Spectrum Generator Pro
- » easy Monte Carlo
- » Cambio file Converter
- » Extended Graph Module

Welcome, F.Ray

[My Settings](#)
[Networking](#)

► **My Last Nuclides**

- 92 U235
- 92 U238
- 36 Kr81 m
- 37 Rb81
- 55 Cs137


► My Nuclide Mixtures

- U232+Co60
- Decay of 1 Grams of 37 Rb 81 after 10 Hours
- Transuranics in 1 ton Spent Fuel
- Natural Uranium
- Natural Thorium

► **My Sources**

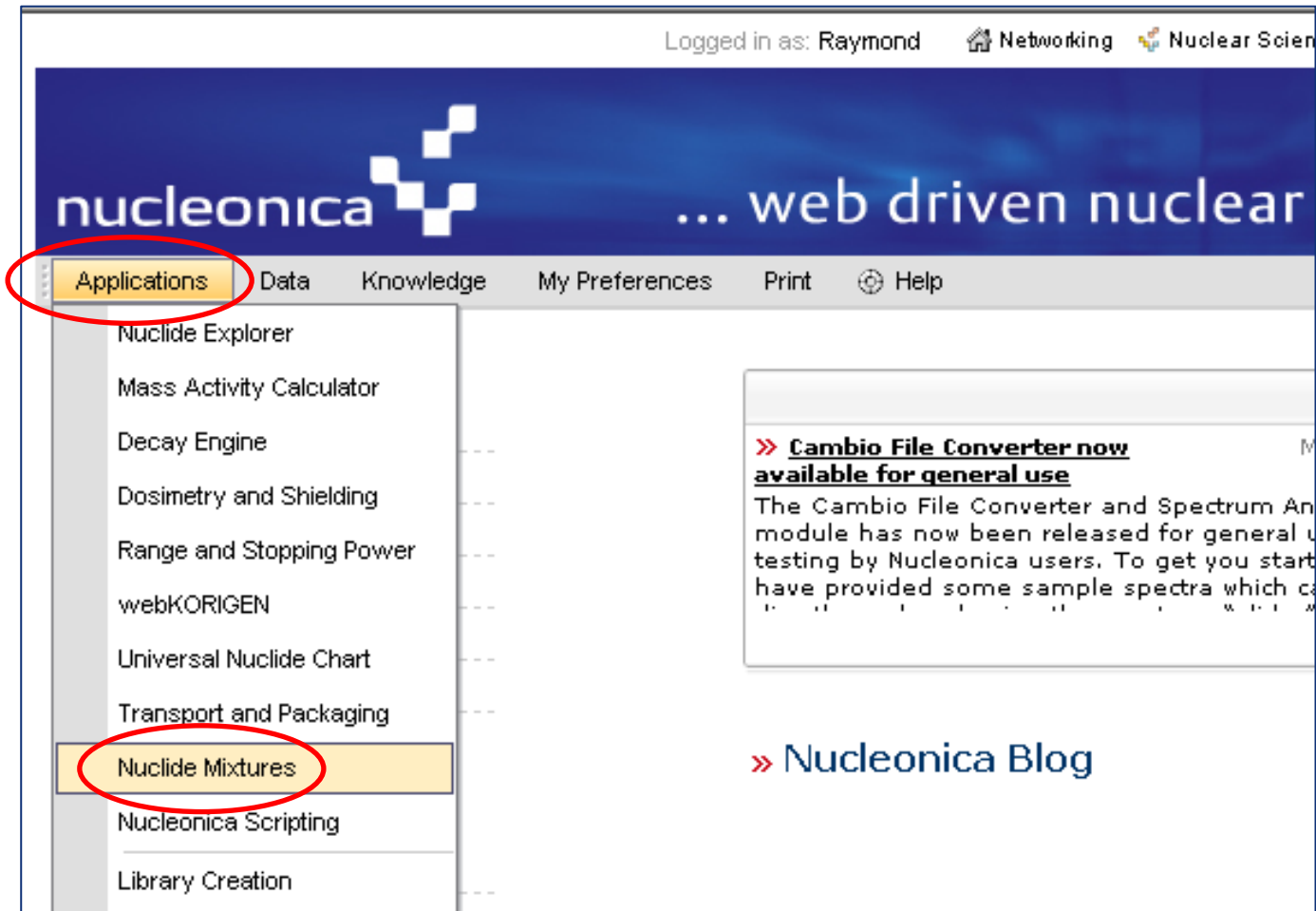
► **My Messages**

► **Search Nucleonica Documentation**

 Nuclear Data Retrieval

► **Data Centre**

Go to Nuclide Mixtures



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Applications Data Knowledge My Preferences Print Help

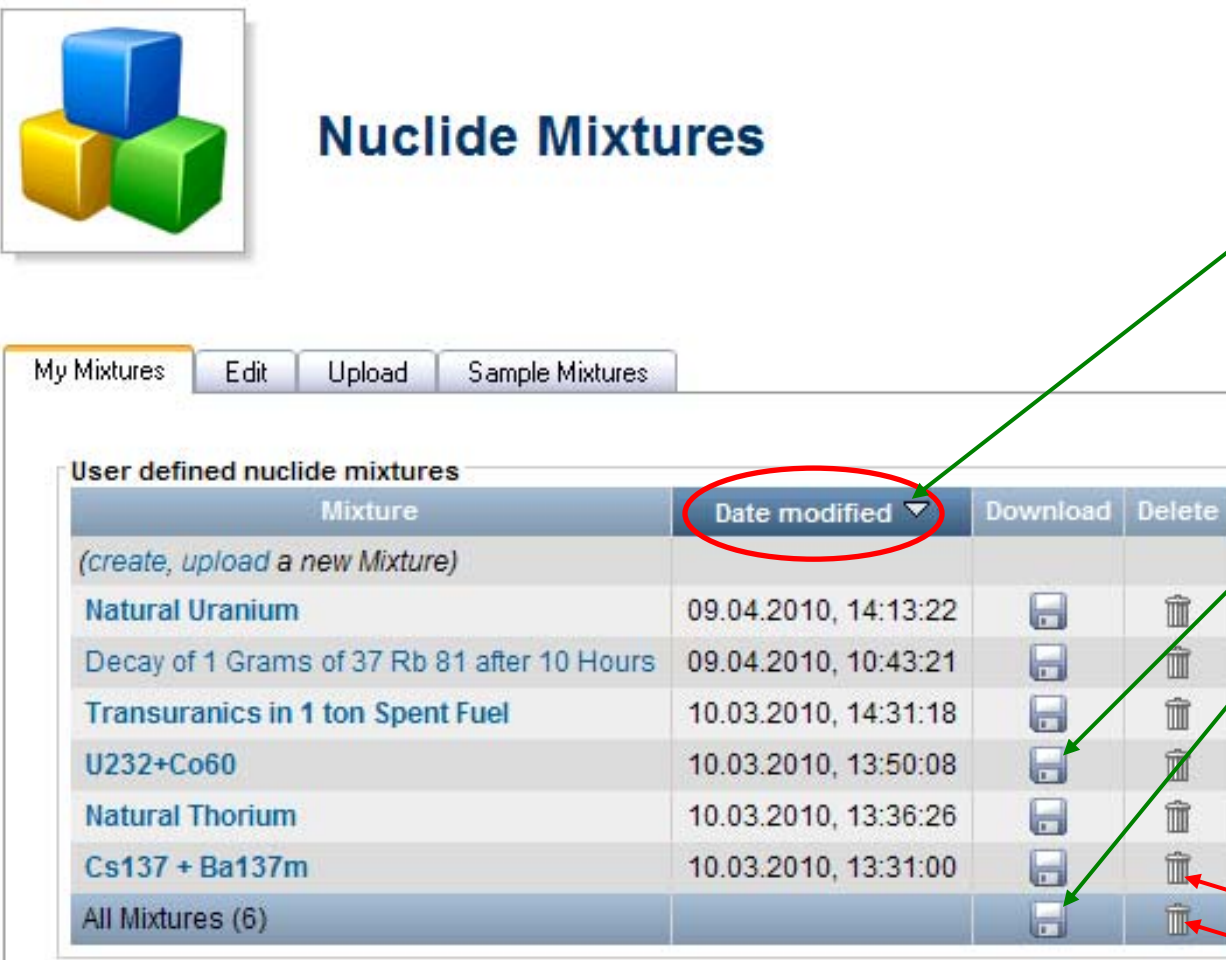
- Nuclide Explorer
- Mass Activity Calculator
- Decay Engine
- Dosimetry and Shielding
- Range and Stopping Power
- webKORIGEN
- Universal Nuclide Chart
- Transport and Packaging
- Nuclide Mixtures**
- Nucleonica Scripting
- Library Creation

>> Cambio File Converter now available for general use

The Cambio File Converter and Spectrum Analysis module has now been released for general use and testing by Nucleonica users. To get you started we have provided some sample spectra which can be downloaded from the [Cambio File Converter](#) page.

>> Nucleonica Blog

Nuclide Mixtures: Overview



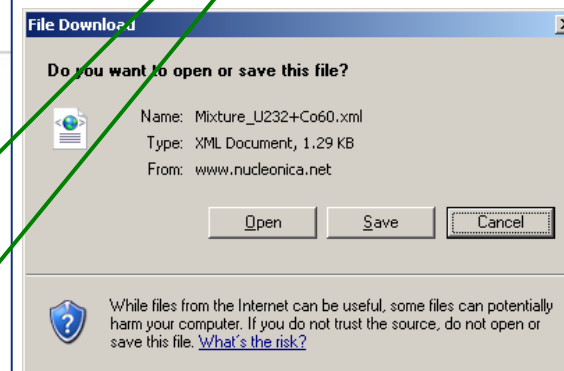
The interface shows a header with a logo of three colored cubes (blue, yellow, green) and the title "Nuclide Mixtures". Below the header is a navigation bar with buttons: "My Mixtures", "Edit", "Upload", and "Sample Mixtures". The main content area is titled "User defined nuclide mixtures" and contains a table with columns: "Mixture", "Date modified", "Download", and "Delete". The table lists several mixtures, including "Natural Uranium", "Decay of 1 Grams of 37 Rb 81 after 10 Hours", "Transuranics in 1 ton Spent Fuel", "U232+Co60", "Natural Thorium", "Cs137 + Ba137m", and "All Mixtures (6)". The "Date modified" column is circled in red, and a green arrow points to it from the text "Sorted by Date, descending order". A green arrow points from the "Download" column to the text "Download (as XML file)". A red arrow points from the "Delete" column to the text "Delete".

Mixture	Date modified	Download	Delete
<i>(create, upload a new Mixture)</i>			
Natural Uranium	09.04.2010, 14:13:22		
Decay of 1 Grams of 37 Rb 81 after 10 Hours	09.04.2010, 10:43:21		
Transuranics in 1 ton Spent Fuel	10.03.2010, 14:31:18		
U232+Co60	10.03.2010, 13:50:08		
Natural Thorium	10.03.2010, 13:36:26		
Cs137 + Ba137m	10.03.2010, 13:31:00		
All Mixtures (6)			

Sorted by Date,
descending order

Download (as XML file)

- This mixture
- All mixtures



Delete

- This mixture
- All mixtures

Nuclide Mixtures: Components

My Mixtures Edit Upload Sample Mixtures

Name
Natural Uranium

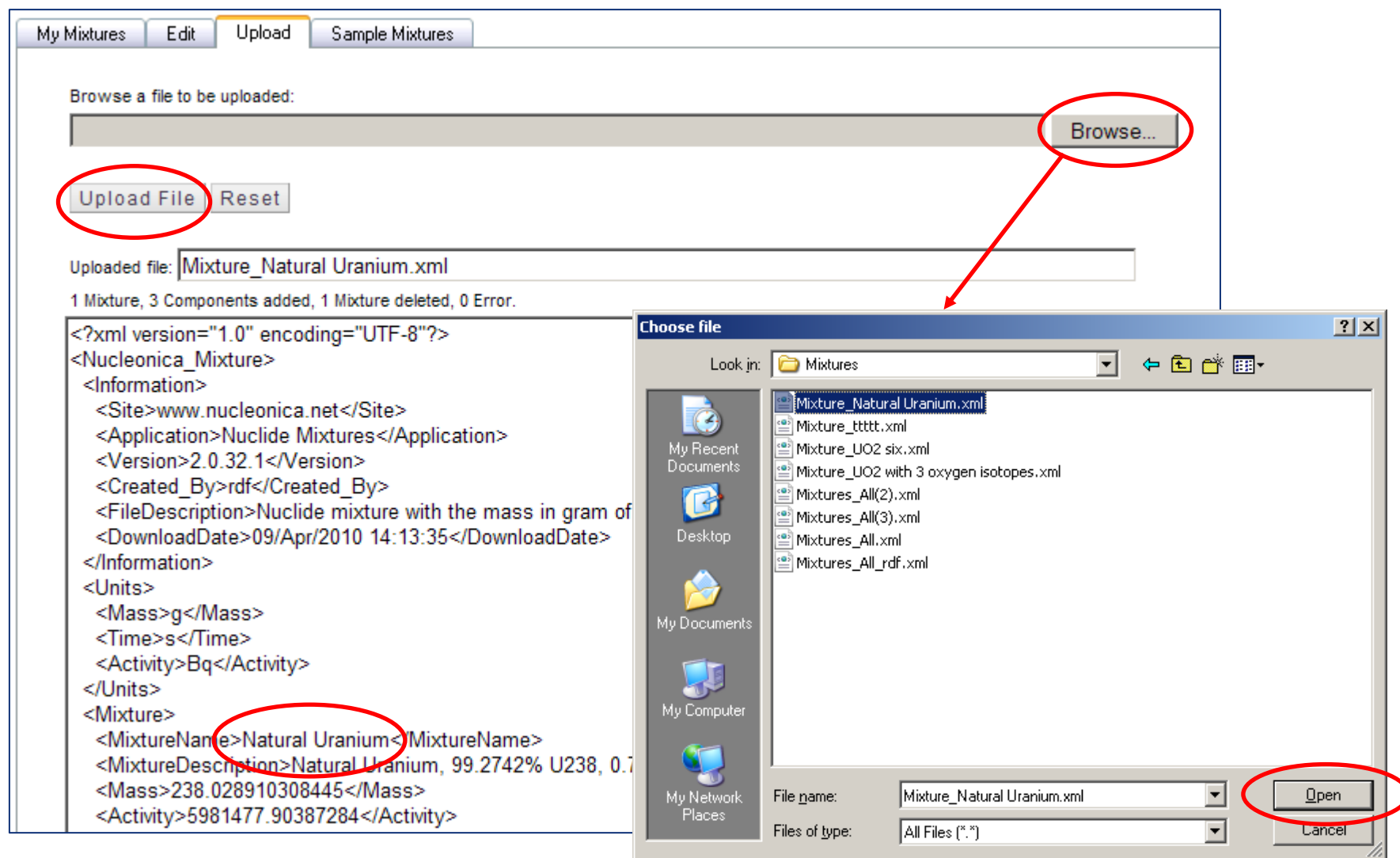
Description:
1 mole natural uranium (U234, U235, U238) with isotopes fractions corresponding to the

Nuclide ▲	Activity(Bq)	Mass(g)	Mass ratio	Mole ratio	Activity ratio	Delete
<i>(add a new Nuclide)</i>						
92 U 234	2.907e+6	0.01264	5.310e-5	5.400e-5	0.4860	🗑
92 U 235	1.354e+5	1.693	7.114e-3	7.204e-3	0.02264	🗑
92 U 238	2.939e+6	236.3	0.9928	0.9927	0.4913	🗑
Total: 3	5.981e+6	238.0	1.000	1	1	🗑

Significant figures: 4 ▼

Masses: Reference quantities for all conversions

Upload Nuclide Mixtures



Nuclide Mixtures: Sample Mixtures

My Mixtures

Edit

Upload


Sample Mixtures

Select	Sample Mixture Name	Date Modified
<input checked="" type="checkbox"/>	Cs137 + Ba137m	10.03.2010, 13:31:00
<input checked="" type="checkbox"/>	Natural Thorium	10.03.2010, 13:36:26
<input checked="" type="checkbox"/>	Natural Uranium	08.04.2010, 15:50:06
<input checked="" type="checkbox"/>	Transuranics in 1 ton Spent Fuel	10.03.2010, 14:31:18
<input checked="" type="checkbox"/>	U232+Co60	10.03.2010, 13:50:08

Send to My Mixtures

Create a new Mixture

1. In Edit, enter a **name** (mandatory) for the mixture
2. Enter a short description (recommended)
3. Enter components → „(add a new nuclide)“
 - Choose a nuclide
 - Select a unit
 - Enter the quantity
 - Update the grid
4. Save the mixture



Nuclide Mixtures

My Mixtures Edit Upload Sample Mixtures

Name
My U232+Co60 mixture

Description:
1g U232+Co60

Nuclide ▲	Activity(Bq)	Mass(g)	Mass ratio	Mole ratio	Activity ratio	Delete
(add a new Nuclide)						
Total: 0	0	0	0	0	0	

Significant figures: 4 ▼

Element	Mass	Quantity	Unit
U ▼	232 ▼	0.4	Gram ▼

Update

Save Mixture Reset Cancel

Create a new Mixture

My Mixtures Edit Upload Sample Mixtures

Name

Description:

Nuclide ▲	Activity(Bq)	Mass(g)	Mass ratio	Mole ratio	Activity ratio	Delete
<i>(add a new Nuclide)</i>						
27 Co 60	2.512e+13	0.6	0.6	0.8531	0.9872	
92 U 232	3.267e+11	0.4	0.4	0.1469	0.01284	
Total: 2	2.545e+13	1	1	1	1	

Significant figures:

Element

Mass

Quantity

Unit

Update

Save Mixture

Reset

Cancel

Case study: Natural Uranium

1. Create a nuclide mixture for 100 g uranium

Hint 1: Create a nuclide mixture for 100 atoms of uranium using the isotopic abundancies of natural Uranium from Nuclide Datasheets or from Nuclide explorer

Hint 2: Use rescale feature to transform from 100 atoms to 100 g

2. Obtain the atomic weight of uranium

	U234 0.0054	U235 0.7204	U236 2.4E7 y	U237 6.75 d	U238 99.2742	
	2.5E5 y	26 m	7.0E8 y		4.5E9 y	
	Pa233 27 d	Pa234	Pa235 24.2 m	Pa236 9.1 m	Pa237 8.7 m	

Case study: Create a new Mixture

My Mixtures

Edit

Upload

Sample Mixtures

Name

My natural Uranium

Description:

My natural Uranium:
99.2742 atom% U238
0.7204 atom% U235
0.0054 atom% U234

Nuclide ▲	Activity(Bq)	Mass(g)	Mass ratio	Mole ratio	Activity ratio	Delete
(add a new Nuclide)						
Total: 0	0	0	0	0	0	

Element

Mass

Quantity

Unit

U

238

99.2742

Number of Atoms

Update

Save Mixture

Reset

Cancel

U238
99.2742
4.5E9 y

Nuclide Database

92 Uranium

Current Chart: Karlsruhe

Element:

Mass:

U

238

Reference Data

Description

Derived Data

Cross S

» Reference Data Notes

Density	19.1 g/cm ³
Mass Excess	47308.948 (± 1904) keV
Atomic Mass	238.050788247 (± 2044) u
Half-life	4.468 (± 3) Gy
Spin	0 ħ
Parity	+
Binding Energy	7.57012 MeV/nucleon
Abundance	99.2742 (± 10) atom %

Case study: Add Uranium components

My Mixtures Edit Upload Sample Mixtures

Name
My natural Uranium

Description:
My natural Uranium:
99.2742 atom% U238
0.7204 atom% U235
0.0054 atom% U234

Nuclide ▲	Activity(Bq)	Mass(g)	Mass ratio	Mole ratio	Activity ratio	Delete
<i>(add a new Nuclide)</i>						
92 U 235	2.24826e-17	2.81172e-22	7.11404e-3	7.20439e-3	0.0440393	🗑️
92 U 238	4.88029e-16	3.92424e-20	0.992886	0.992796	0.955961	🗑️
Total: 2	5.10512e-16	3.95235e-20	1	1	1	🗑️

Element Mass Quantity Unit

U 235 0.7204 Number of Atoms Update

Save Mixture Reset Cancel

U235
0.7204

26 m 7.0E8 y

Nuclide Data

92 Uranium

Current Chart: Karlsruhe

Element: Mass:

U 235 🗨️

Reference Data Description Derived Data Other

» Reference Data Notes

Density	19.1 g/cm ³
Mass Excess	40920.456 (± 1823) keV
Atomic Mass	235.043929918 (± 1957) u
Half-life	703.8 (± 5) My
Spin	7/2 ħ
Parity	-
Binding Energy	7.59091 MeV/nucleon
Abundance	0.7204 (± 6) atom %

Case study: RescaleTotal quantity

My Mixtures
Edit
Upload
Sample Mixtures

Name

Description:

Nuclide ▲	Activity(Bq)	Mass(g)	Mass ratio	Mole ratio	Activity ratio	Delete
<i>(add a new Nuclide)</i>						
92 U 234	4.8273660e-16	2.0986240e-24	5.3095279e-5	5.4000000e-5	0.48601799	
92 U 235	2.2482608e-17	2.8117180e-22	7.1136589e-3	0.007204	0.022635433	
92 U 238	4.8802922e-16	3.9242353e-20	0.99283325	0.992742	0.49134658	
Total: 3	9.9324843e-16	3.9525624e-20	1	1	1	

Element
Mass
Quantity
Unit

Nuclide Data
92 Uranium
Current Chart: Karlsruhe

Element:
Mass:

Reference Data
Description
Derived Data

» Reference Data Notes

Density	19.1 g/cm ³
Mass Excess	38146.625 (± 1827) keV
Atomic Mass	234.040952088 (± 1960)
Half-life	245.7 (± 3) ky
Spin	0 ħ
Parity	+
Binding Energy	7.60071 MeV/nucleon
Abundance	0.0054 (± 5) atom %

Case study: Total rescaled to 100 g

My Mixtures Edit Upload Sample Mixtures

Name

My natural Uranium

Description:

My natural Uranium:
99.2742 atom% U238
0.7204 atom% U235
0.0054 atom% U234

Nuclide ▲	Activity(Bq)	Mass(g)	Mass ratio	Mole ratio	Activity ratio	Delete
<i>(add a new Nuclide)</i>						
92 U 234	1.2213257e+6	5.3095279e-3	5.3095279e-5	5.4000000e-5	0.48601799	🗑
92 U 235	5.6881097e+4	0.71136589	7.1136589e-3	7.2040000e-3	0.022635433	🗑
92 U 238	1.2347160e+6	99.283325	0.99283325	0.992742	0.49134658	🗑
Total: 3	2.5129228e+6	100	1	1	1	🗑

Significant figures: 8 ▼

Element

Mass

Quantity

Unit

100

Gram

Update

Save Mixture

Reset

Cancel

Case study: Atomic weight of U

My Mixtures Edit Upload Sample Mixtures

Name
My natural Uranium

Description:
My natural Uranium:
99.2742 atom% U238
0.7204 atom% U235
0.0054 atom% U234

Nuclide ▲	Activity(Bq)	Mass(g)	Mass ratio	Mole ratio	Activity ratio	Delete
<i>(add a new Nuclide)</i>						
92 U 234	2.9071083e+6	0.012638211	5.3095279e-5	5.4000000e-5	0.48601799	🗑
92 U 235	1.3539346e+5	1.6932565	7.1136589e-3	0.007204	0.022635433	🗑
92 U 238	2.9389812e+6	236.32302	0.99283325	0.992742	0.49134658	🗑
Total: 3	5.9814829e+6	238.02891	1.0000000	1	1	🗑

Significant figures: 8 ▼

Element Mass Quantity Unit
▼ ▼ 1 Mole Update

Save Mixture Reset Cancel

Comparing with Karlsruhe Nuclide Chart: 238.02891

Mixtures in Nucleonica

1. Nuclide mixtures overview e.g. U232+Co60
2. Case study with natural uranium
3. Exercise

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Using Nuclide Mixtures in Nucleonica

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